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BACTERIOLOGY

AMONG the most striking of the recent rapid advances of science is the development of what we may term bacteriology. For more than one hundred years a debate had been going on as to the origin of the minute forms of life which were present in decomposing organic materials, but till the publications of Cagniard-Latour and Schwann no part was assigned to them in the production of the chemical changes which these materials undergo. It was not, however, till the publication of Pasteur's papers on the alcoholic fermentation and on spontaneous generation little more than twenty years ago that any sound basis was obtained for the idea that a micro-organism was able to cause fermentation. The science of bacteriology really dates its commencement from the first publication of Pasteur's papers. Following rapidly on this work, researches have been carried on which have now demonstrated that all the fermentations belonging to the same class as the alcoholic fermentation are due to the development of micro-organisms, and that bacteria are most important factors in Nature, being the chief agents by which the complex organic constituents of plants and animals are brought back to simple forms capable of serving again as food for plants.

But the researches have not been confined to the study of fermentations. In 1851, Rayer and Daraine observed in the blood of animals suffering from splenic fever the presence of numerous small rods which were supposed to be crystals. On the publication of Pasteur's papers, Daraine again took up the subject, and came to the conclusion that these rods were bacteria and the cause of the disease. For some years little was done in this direction, though microscopical observations on the occurrence of bacteria in various diseases were described. With the publication of the investigations of Koch and Pasteur on anthrax, and more especially of Koch's modes of cultivation, a new start was made, and these researches have since been carried on with a certainty and a precision that could not have been anticipated, and have led to the accumulation of a large amount of knowledge with regard to the causation of infective diseases. A causal relation has been established between bacteria and splenic fever, various septicæmic affections, and infective diseases in the lower animals, tuberculosis, glanders, erysipelas, and other diseases in man; while in a number of other cases, in which the causal relation has not been completely demonstrated, facts have been made out which render it extremely probable. In spite, however, of this large addition to our knowledge, the subject is as yet little more than in its infancy, numerous questions of the greatest importance and likely to lead to the most important results still requiring investigation.

Apart from its purely scientific interest there is perhaps no department of science which so nearly concerns the health and well-being of the community, and already important practical results have been obtained, affecting medicine, industry, and public health. Following closely on Pasteur's early publications, and as a direct result of them, we have the great revolution in surgery brought about by Sir Joseph Lister, resulting in such improvements in the management of wounds as have been the means of saving numerous lives and of greatly enlarging the scope of surgical interference. Our knowledge of the value of disinfectants, of the mode of spread of infective disease, and of the precautions necessary to prevent its spread has also been very largely increased, and must lead to great improvements in hygiene. Nor must we omit to mention the valuable experiments begun by Toussaint and Pasteur, and now being carried on to a large extent by Pasteur, on the attenuation of virus and the conversion of virulent micro-organisms into useful vaccines. This has been demonstrated to be possible in the cases of chicken cholera, anthrax, pig typhoid, and possibly hydrophobia, and has been put practically into force in France in the case of the first three affections. Useful facts affecting various industries have also been made out. The deplorable condition of the silkworm industry some years ago and Pasteur's investigations thereon are well known, and have led to the restoration of the silk manufacture; while his work on diseases of beer and wine, and the work of others on various fermentations, have proved of the greatest benefit.

While some of this work has been done in this country, by far the greater part has been done abroad, more especially in Germany and France, where its importance is recognised, and where special facilities are afforded by the Governments and various public bodies. In Germany especially, besides the laboratory, supported by the Government, in which Dr. Koch works, a number of similar institutions are being established throughout the country; and in France the laboratories of Pasteur and others are established and supported by the Government and by various municipal authorities, every facility for carrying on these researches, and the necessary funds, being provided. In this country, on the other hand, there is no laboratory of the kind, and what work has been done has been by individual investigators working at their own expense, and often without suitable accommodation. To carry on this work a considerable amount of apparatus is necessary, an assistant is required, and the use of a laboratory where animals can be kept is essential. Without the help of a trained assistant, the investigator's time must be largely taken up in the sterilisation and preparation of his cultivating media and in other manual work, leaving but little time for actual investigation, more especially if, as is often the case, teaching or medical practice must be carried on as well in order to earn a livelihood. How different are the conditions where a well-equipped laboratory is provided, where trained assistants are present, and where a salary is given sufficient to enable the investigator to devote his whole time to the work. Surely it would be possible to establish a proper laboratory in this country.

That the matter is felt to be of importance was shown last summer by the fact that the Executive Council of the Health Exhibition devoted a considerable sum to the establishment of a model laboratory under the direction of Mr. Watson Cheyne, in which many of the results and the most recent methods of investigation were shown. This laboratory was visited by large numbers of scientific men and others, and the hope was universally expressed that the model would become the basis of a permanent institution. We

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are glad to hear that the Executive Council of the Exhibition are taking into consideration the advisability of devoting their surplus funds to this object, and we hope that they may ultimately resolve to do so. They could not better advance the cause of hygiene, and more fittingly carry on and perpetuate the work begun by the Exhibition. The sum required to build and adequately endow such a laboratory would of course be considerable, but there can be little doubt that, once the matter is started, various public bodies will aid in the work, while a suitable site at South Kensington might be obtained from the Commissioners, as there the laboratory would be in the vicinity of those belonging to the Science and Art Department and the City and Guilds Institute.

HEROES OF SCIENCE

Heroes of Science: Mechanicians. By T. C. Lewis, M.A. (London: Published under the direction of the Society for Promoting Christian Knowledge, 1884.)

IN this volume short histories are given of the following inventors:—Watt, George Stephenson, Richard Arkwright, Crompton, Maudsley, Joseph Clement, James Nasmyth, Whitworth, and Babbage. The facts told of the lives of these men have been gathered from reliable sources and are accurate. It is unfortunate that Prof. Lewis did not introduce more of these facts in his book instead of using up its very limited space by inserting an inordinate amount of moralising, which is extremely tantalising, and makes it often difficult to proceed owing to the impatience which it causes. No words that could be used by way of reflection, even by a great writer, could add much to the moral stimulus afforded by the simple narrative of the lives of men like Watt and Stephenson, and the style which we encounter here, although often very ambitious, signally fails in attaining its mark and, instead of increasing our admiration for the men described, adds an unwelcome tinge of the ridiculous to the account. Thus in describing the early life of Arkwright we meet with these sentences amongst others:—"Before this he was probably as well off as most itinerant dealers in hair of his rank, but this first decisive step of his" [that from a village barber to a dealer in hair] "was enough to show that he could be dominated by an idea even to the length of relinquishing some certainties of advantage." "Whilst he was doing his unexciting work of preparing orderly cover for the outside of other men's heads" [this means making wigs] "he was—apparently too without much mental excitement—introducing order and exercising thought in the interior of his own; in consequence of which it appears that, whatever he did in those days to cover the heads of thinking and thoughtless men and women with a fair show of hair, he has done more for us in providing for the inside of ours some furniture of profitable thought," &c.

Amongst many curious pieces of information which we come across we may draw attention to the following piece of social history probably hitherto unknown. "When Adam delved and Eve span, or when their descendants first adopted this division of labour, the work of digging was carried on in the sweat of the brow, it required strength, and was relegated to the man; the process of spinning, which required less strength than dexterity, was assigned to the woman." Neither in Genesis nor in the *Transactions* of the Anthropological Society do we remember having seen any account of this early example of the division of labour. Valuable practice in English construction after the manner of the old so-called orthographical exercises, might be set on this book, by asking boys studying English to criticise and explain (if possible) the meaning of the phrases in italics in the following sentences:—(Page 155) "In him we look in vain for *the disinterestedness that endears self-sacrifice to us.*" (P. 253) "The revolution that was being effected by the introduction of machine tools, was, like all revolutions, sure to meet with resistance. It is not too much to say that by its means *a little one became a thousand.*" As a piece of grandiloquent writing, of which we here find many samples, we may instance this (p. 211):—"Modern inventions succeed one another like the links of a golden chain forged by men of god-like skill for our support, and indeed for our elevation. The cloak of an Elijah often falls upon the shoulders of an Elisha."

We are curious to know if the assailers of classical education have ever used stronger language than is here employed in describing Nasmyth's studies (p. 212):—"The classical education they had attempted with little success to give to him there was not at all suited to his bent. He asked for food, and they gave him a nauseous poison." In these days when the working man is so courted and admired, we should have thought it, to say the least, unnecessary to inform the readers of this book that (p. 202) "in all his (Clement's) work . . . there was an interest in his art which in his case raised it above the labour of a calling," or (p. 232), "in labour such as his (Nasmyth's) there was no degradation." This too after he had become an employer of labour himself!

Besides committing great errors of style, the author occasionally errs as to matters of fact. Thus (p. xiv.), he says, "The world has had to be content with using from two and a half to four pounds of coal for" one horse-power. The limit would have been put much lower had he studied the records of the engines of the best American liners. On p. 57 a description is given of "the double-acting steam-engine, in which steam is admitted to press the piston both upwards and downwards, the piston being also aided in its motion by a vacuum produced by condensation on the side towards which the steam is pressing it." To say that the piston motion is "*aided*" by the vacuum on the opposite side to that on which steam is acting is a curious way of representing the fact that without such a vacuum no motion of the piston would be *possible*. The definition of parallel motion given is new. On p. 58 we read, "The specification included . . . the contrivance for parallel motion or for making the piston-rod move perpendicularly up and down without chains or perpendicular guides, or untowardly friction, arch heads, or other pieces of clumsiness."

The book, which we are informed (p. vi.) is intended for boys, does not give enough explanation. The descriptions of inventions given are of the briefest, and will be quite unintelligible to any one who has not already spent a considerable amount of time in studying them elsewhere. If Prof. Lewis had been content to omit the wearisome reflections which he has placed in the book, and had,

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